

इंटरनेट

मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 11298-3-4 (1998): Plastic films for electrical purposes, Part 3: Specifications for individual materials, Section 4: Requirements for polycarbonate (PC) films used for electrical insulation [ETD 2: Solid Electrical Insulating Materials and Insulation Systems]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE



भारतीय मानक

विद्युत प्रयोजनों के लिए प्लास्टिक फिल्म

भाग 3 अलग-अलग सामग्रियों की विशिष्टियाँ
अनुभाग 4 विद्युत रोधन में प्रयुक्त पालीकार्बोनेट (पीसी) फिल्म की अपेक्षाएँ

Indian Standard

PLASTIC FILMS FOR ELECTRICAL PURPOSES

PART 3 SPECIFICATIONS FOR INDIVIDUAL MATERIALS

**Section 4 Requirements for Polycarbonate (PC)
Films Used for Electrical Insulation**

ICS 29.035.20 : 83.140.10

© BIS 1998

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 1998

Price Group 4

NATIONAL FOREWORD

This Indian Standard is identical with IEC PUB 674-3-3 (1992) 'Specification for plastic films for electrical purposes — Part 3 : Specifications for individual materials — Sheet 3 : Requirements for polycarbonate (PC) films used for electrical insulation' issued by the International Electrotechnical Commission (IEC) and was adopted by the Bureau of Indian Standards on the recommendation of the Solid Electrical Insulating Materials Sectional Committee (ETD 02) and approval of the Electrotechnical Division Council.

This standard (Part 3/Sec 4) is one of the series of Indian Standards which deal with plastic films for electrical purposes. The series consists of the following parts:

- Part 1 Definitions and general requirements
- Part 2 Methods of test
- Part 3 Individual materials — Specifications

This standard (Part 3/ Sec 4) covers the requirements for polycarbonate films, for use as electrical insulation.

In this Indian Standard, wherever reference appears to IEC 674-1 :1980 'Specification for plastic films for electrical purposes — Part 1 : Definitions and general requirements', it shall be read as IS 11298 (Part 1) : 1985 'Plastic films for electrical purposes : Part 1 Definitions and general requirements ; IEC 674-2 : 1988 'Specification for plastic films for electrical purposes — Part 2 : Methods of test' shall be read as IS 11298 (Part 2) : 1987 'Plastic films for electrical purposes : Part 2 Methods of test'; and IEC 674-3-3 : 1992 'Specification for plastic films for electrical purposes — Part 3 : Specifications for individual materials — Sheet 3 : Requirements for polycarbonate (PC) films used for electrical insulation' shall be read as IS 11298 (Part 3/Sec 4) : 1998. The above IEC standards are equivalent to the respective Indian Standards. For IEC 757 : 1983 there is no equivalent Indian Standard at present.

Certain conventions appearing in this dual number standard are not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard';
- b) Comma (,) has been used as decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

Only the English language text in the IEC standard has been retained while adopting it in this Indian Standard.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

PLASTIC FILMS FOR ELECTRICAL PURPOSES

PART 3 SPECIFICATIONS FOR INDIVIDUAL MATERIALS

Section 4 Requirements for Polycarbonate (PC) Films Used for Electrical Insulation

1 General

1.1 Scope

This International Standard gives the requirements for polycarbonate films, for use as electrical insulation.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 674-1: 1980, *Specification for plastic films for electrical purposes - Part 1: Definitions and general requirements.*

IEC 674-2: 1988, *Specification for plastic films for electrical purposes - Part 2: Methods of test.*

IEC 757: 1983, *Code for designation of colours.*

1.3 Classification

The polycarbonate film shall be of the following types:

Type 1: General purpose amorphous, unstretched;

Type 2: General purpose amorphous, stretched;

Type 3: For use as the dielectric of capacitors, partially crystalline and stretched.

These three types are available in regular and in flame-retardant types.

2 Designation

The plastic film shall be identified by the designation which follows:

Designation of the film - IEC 674-3-3 - PC - type - thickness in micrometres - width in millimetres - length in metres - colour.

Example:

Polycarbonate film IEC 674-3-3 - PC - type 1 - 100 - 20 - 200 - nc - f

(f = flame-retardant; r = regular; nc = natural colour; other colours according to IEC 757).

3 General requirements

The material shall be made from bisphenol-A-polycarbonate.

Flame-retardant grades shall be made from a blend of bisphenol-A-polycarbonate and brominated bisphenol-A-polycarbonate.

The material shall be a flexible, self-supporting film. All types shall conform to the general requirements laid down in IEC 674-1.

For certain applications, additives to the base material may be present (e.g. thermal or UV stabilisers, dyes or pigments for identification purposes).

Where such additives are used, they shall not affect the requirements for any of the properties listed for that type, unless otherwise specified.

4 Dimensions

4.1 Thickness

The film thickness shall be measured by a gravimetric method in accordance with the requirements of 3.3 of IEC 674-2.

NOTES

- 1 There are no requirements for thickness in this standard, but preferred thicknesses are as follows:

2, 3, 4, 5, 6, 7, 8, 10, 12, 15, 20, 25, 30, 40, 50, 60, 75, 80, 100, 120, 125, 150, 180, 200, 250, 380, 500 and 760 μm .
- 2 The following thicknesses are commonly available:

Table 1 – Type and thickness range

Type	Thickness range for all types μm
1	20 - 760
2	20 - 100
3	2 - 60

The thickness tolerance shall comply with the requirements in 4.1 of IEC 674-1, unless otherwise specified in the purchase contract.

4.2 Width

The film width shall be measured in accordance with the requirements of clause 5 of IEC 674-2.

Preferred widths cannot be given on account of the great variety of applications.

The tolerance on the width shall comply with the requirements in 4.2 of IEC 674-1.

5 Properties

5.1 Properties not dependent on thickness, all types, both regular and flame-retardant

Table 2 – Property requirements for all types

Property	Requirement	Unit	IEC 674-2 Test method Clause	Type
Density - normal	1 200 ± 20 1 210 ± 20	kg/m ³	4, method A	1 and 2 3
Density flame-retardant	3)	kg/m ³	4, method A	1, 2 and 3
Melting-point	Under consideration			3
Permittivity	3,0 ± 0,1 3,0 ± 0,1		16.1 ¹⁾ 23 °C, 48 Hz - 62 Hz 23 °C, 1 kHz	1, 2 and 3
Dissipation factor	<0,0020 <0,0022		16.1 ¹⁾ 23 °C, 48 Hz - 62 Hz 23 °C, 1 kHz	1 and 2
	<0,0012 <0,0015		16.2, 23 °C, 48 Hz - 62 Hz 16.2, 23 °C, 1 kHz	3
Volume resistivity	≥1 x 10 ¹⁴ ≥1 x 10 ¹⁵	Ω · m	15.1 ²⁾	1 2 and 3
Surface resistivity	≥1 x 10 ¹⁵	Ω	14 ²⁾	1, 2 and 3
Electrolytic corrosion	A1	–	21 Visual test	1, 2 and 3
	<2	%	21 Tensile wire test	
Dimensional change with rising temperature: under tension	>145 >220	°C °C	24	1 and 2 3
under pressure	>175 >180	°C °C	25	1 and 2 3
<p>¹⁾ Use non-contacting electrodes or evaporated metal electrodes.</p> <p>²⁾ Measurement conditions to be 23 °C and 50 % r.h. after 24 hours exposure. The test voltages are 100 V ± 10 V for thicknesses >10 µm and 10 V for thicknesses ≤10 µm.</p> <p>³⁾ The nominal density shall be as specified in the purchase contract. Typical values for nominal densities are in the range of 1 260 kg/m³ - 1 440 kg/m³. The actual density shall not differ from the nominal density by more than ±20 kg/m³.</p>				

5.2 Properties dependent on thickness

Table 3 – Property values for all types

Property	Types	IEC 674-2 Test method	Nominal thickness μm				Units
			<100		≥ 100		
			Machine direction	Transverse direction	Machine direction	Transverse direction	
Tensile strength	1	$10^{1)}$	80	80	60	60	MPa
Minimum values	2		130	80	–	–	
	3		$180^{2)}$	60	–	–	
Elongation at break	1	$10^{1)}$	100	100	80	80	%
Minimum values	2		40	100	–	–	
	3		$40^{2)}$	100	–	–	
Dimensional change	1	23	<3	<3	<3	<3	%
Shrinkage	2	(160 °C)	>25	<3	–	–	
	3	(30 min)	<14	<3	–	–	
1) Rate of extension 100 mm/min, reference lines 100 mm apart.							
2) No requirement for film below 5 μm .							

Table 4 – Electric strength (a.c. test) for all types

Nominal thickness μm	Minimum electric strength $\text{V}/\mu\text{m}$	IEC 674-2 Test method Clause
6	260	18.1 Using 6 mm diameter electrodes in air
15	260	
20	250	
30	250	
40	190	
60	160	18.1 Using 6 mm diameter electrodes in transformer oil
100	100	
150	80	
200	70	
250	60	
380	60	
760	60	

Table 5 – Electric strength (d.c. test) for type 3 only

Test method - 18.2 of IEC 674-2

Nominal thickness μm	Breakdown voltage Minimum central value V	Not more than two of the 21 results shall be below V	Not more than one of the 21 results shall be below V
8	1 000	500	400
10	1 500	800	500
12	2 400	1 500	700
15	2 700	2 000	800
20	2 800	2 400	1 500

Electrical weak spots (type 3 only)

When measured according to 19.3 of IEC 674-2 with a test voltage of 110 V/ μm based on the nominal thickness of the film, the number of faults counted shall not exceed the numbers given in table 6.

Table 6 – Number of faults counted

Nominal thickness μm	Fault count/ m^2
3	5
4	4
5	2
6	2
8	0,8
10	0,3
12	0,2

5.3 Other properties

5.3.1 Thermal endurance

The thermal endurance shall be measured in accordance with the requirements of clause 28 of IEC 674-2.

The end point criterion shall be 50 % retention of the original elongation at break value.

The temperature index for films of types 1 and 2 shall be not less than 130. There is no requirement for type 3. The recommended ageing temperatures are 140 °C, 160 °C, 180 °C, 200 °C.

5.3.2 Burning characteristics

Regular type

No requirement

Flame-retardant type

When determined according to clause 29 of IEC 674-2, the classification shall be VTFO for materials thicker than 20 µm. For thicknesses more than 250 µm, not applicable.

6 Roll characteristics for all types

6.1 Roll diameter / film length

There are no requirements in this standard for roll diameters or film lengths on a roll. These should be subject to contract.

6.2 Windability (bias/camber and sag)

The windability shall be measured in accordance with the requirements of clause 6 of IEC 674-2. Requirements as in table 7.

Table 7 – Windability

Film width mm	Test method	Bias/camber mm	Maximum extension
<150	A	<10	–
≥150 ¹⁾	B	–	0,1 %
¹⁾ There is no requirement for film thicknesses greater than 20 µm.			

6.3 Joins

Where joins (splices) are permitted, their construction shall conform to the requirements given in 3.3 of IEC 674-1.

Breaks (unjoined pieces) are not allowed.

The number of joins per 5 000 m length in each roll shall not exceed the values given in table 8.

Table 8 – Maximum permissible number of joins

Nominal thickness µm	Maximum permissible number of joins per 5 000 m length
<3	5
3	4
4	4
5	3
8	3
10	2
15	2
>15	1

6.4 Roll width

The difference between the film width measured according to clause 5 of IEC 674-2 and the roll width excluding the core shall be according to table 9.

Table 9 – Film width

Nominal film width mm	Requirement Maximum difference mm
<150	0,5
150 to 300	1,0
>300	2,0

6.5 Cores

The preferred core inside diameters are 76 mm and 152 mm.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc : No. ET 02 (3868).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 323 01 31, 323 94 02, 323 33 75

Telegrams: Manaksanstha
(Common to
all offices)

Regional Offices:

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110002

Telephone

{ 323 76 17
323 38 41

Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola
CALCUTTA 700054

{ 337 84 99, 337 85 61
337 86 26, 337 86 6.

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022

{ 60 38 43
60 20 25

Southern : C. I. T. Campus, IV Cross Road, CHENNAI 600113

{ 235 02 16, 235 04 42
235 15 19, 235 23 15

Western : Manakalaya, E9 MIDC, Marol, Andheri (East)
MUMBAI 400093

{ 832 92 95, 832 78 58
832 78 91, 832 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR.
COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR.
KANPUR. LUCKNOW. NAGPUR. PATNA. PUNE. THIRUVANANTHAPURAM.